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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/939,842	08/28/2001	Satoshi Maemori	2001-1191A	2942

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EXAMINER

WALKE, AMANDA C

ART UNIT	PAPER NUMBER
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1752

DATE MAILED: 07/07/2003

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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Applicati n N .

09/939,842

Applicant(s)

MAEMORI ET AL

Examiner

Amanda C Walke

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 28 August 2001.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-20 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-7 and 20 is/are rejected.
- 7) ☒ Claim(s) 8-19 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 4.
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

-DETAILED ACTION

Specification

1. The disclosure is objected to because of the following informalities: On page 8, line 15, "2-methyladanantyl" should be "2-methyladamantyl".

Appropriate correction is required.

2. The disclosure is objected to because of the following informalities: On page 22, in Table 1 in the "Comparative Example 2", line, "0,17" should be "0.17".

Appropriate correction is required.

3. The lengthy specification has not been checked to the extent necessary to determine the presence of all possible minor errors. Applicant's cooperation is requested in correcting any errors of which applicant may become aware in the specification.

Claim Objections

4. Claim 10 is objected to because of the following informalities: In line 3, "adamantly" should be "adamantyl". Appropriate correction is required.

Claim Rejections - 35 USC § 102

5. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

6. Claims 1-7 are rejected under 35 U.S.C. 102(b) as being anticipated by Nitta et al (5,945,517).

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Nitta et al disclose a chemically amplified photoresist composition having advantages in contrast and resolution of patterning, photosensitivity, high film thickness retention, and cross sectional image profile, as well as stability of the latent image formed by the pattern-wise exposure to light before the post-baking treatment (abstract, column 1, lines 10-34, and column 2, lines 35-49). This composition comprises a film forming resin component and a radiation sensitive acid-generating component. The resin component is preferably a polyhydroxystyrene resin that is substituted by tert-butoxycarbonyl or alkoxyalkyl groups for 10-50 %, preferably 15-40 % of the hydroxyl groups, and a second polyhydroxystyrene resin that is substituted by alkoxyalkyl groups (such as ethoxyethyl and methoxy-n-propyl groups) for 10-50%, preferably 15-40% of the hydroxyl groups in a weight proportion of from 5:95 to 50:50, preferably 10:90 to 30:70 (column 4, lines 40-67). The alkali soluble resin should have a molecular weight (weight-averaged) in the range of 2,000 to 20,000, and the molecular weight distribution thereof should be as narrow as possible from the standpoint of obtaining a resist layer having good heat resistance and high pattern resolution. The molecular weight distribution represented by the ratio of the weight-averaged molecular weight to the number-averaged molecular weight should not exceed 3.5, or preferably 2.5 for the polyhydroxystyrene-based resin (column 5, lines 35-63). Although the references fails to disclose the molecular weight dispersion as claimed in the present claim 6, given that the reference utilizes an almost identical polyhydroxystyrene component, it is the position of the examiner that the component resin of the reference would inherently meet the present claim limitations for the molecular weight dispersion. The resist composition is preferably employed in a method of producing a semiconductor device like that disclosed in the preamble of the independent claim including the steps of dissolving the resist in

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a solvent, coating the solution onto a substrate, drying the solution to form a photosensitive layer, exposing the layer to radiation, developing the exposed resist to form the resist pattern, and then subjecting the pattern to a post-baking process (column 14, line 54 to column 15, line 44).

Example 1 in column 20 utilizes a positive-working photoresist composition comprised of 30 parts by weight of a first polyhydroxystyrene resin having a weight-averaged molecular weight of 10,000 substituted with tert-butyloxycarbonyl groups for 39% of the hydroxyl groups, and 70 parts by weight of a second polyhydroxystyrene resin having a weight-averaged molecular weight of 10,000 substituted by ethoxyethyl groups for 39% of the hydroxyl groups, which is almost identical to the preferred resin of the present specification. According to the examples, the developer preferably employed is a solution of 2.38% by weight of tetramethylammoniumhydroxide (TMAH) for 60 seconds at a temperature of 23 ° C. The resultant photoresist had the high thickness retention of 98% (see Table 1).

On page 6 of the instant specification, it is stated that the particular preference for the preferred combination of certain resinous compounds is based on the discovery that the requirement for the rate of the film thickness retention "can be complied with relatively easily by using a mixture of these two resinous compounds" (referring to their disclosure of the two preferred resins), meaning that the rate is dependent upon the type of resin employed in the photoresist composition. Given this statement and the exemplified resins of the inventive examples of the instant specification, it can be determined that resins which are quite similar to these will inherently meet the present claim limitations. Although Nitta et al does not specifically disclose the claimed rate, the inventive samples of the reference are nearly identical to those of the instant specification (the only differences are that the molecular weights of the

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reference resins are slightly higher as well as the percentage of hydroxyl groups substituted, but there is only a slight difference, and the molecular weight and the percentages still fall well within the scope of the description on page 6 of the instant specification for the preferred resins) and that film thickness retention is a goal of the invention of the reference, it is the position of the examiner that when made, the photoresist composition of the reference would inherently meet the present claim limitations for the rate of the reduction of thickness.

With respect to the limitation of the present claim 1 which requires that the "photoresist composition of which a layer before the pattern-wise light exposure exhibits a reduction of thickness at 23 o C in a 2.38% by weight aqueous solution of TMAH at a rate in the range from 0.09 to 1.0 nm/second", the examiner notes that the claim does not actually require a method step wherein the resist is developed in this manner, but instead requires that the resist composition would exhibit the claimed reduction of thickness *when subjected* to the aforementioned conditions.

Claim Rejections - 35 USC § 103

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

8. Claim 20 is rejected under 35 U.S.C. 103(a) as being unpatentable over Nitta et al in view of Sato et al (5,736,296).

Nitta et al has been discussed above, but fails to teach the formation of a contact hole in the layer of photoresist.

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Sato et al disclose a positive resist composition comprising a mixture of two polyhydroxystyrenes having different acid cleavable groups and an acid generating compound. The material of the reference utilizes a mixture comprising a positive-working photoresist composition comprised of a first polyhydroxystyrene resin having a weight-averaged molecular weight of 20,000 substituted with tert-butyloxycarbonyloxy groups for 39% of the hydroxyl groups, and a second polyhydroxystyrene resin having a weight-averaged molecular weight of 20,000 substituted by ethoxyethoxy groups for 35% of the hydroxyl groups. The resist composition is preferably employed in a method of producing a semiconductor device including the steps of dissolving the resist in a solvent, coating the solution onto a substrate, drying the solution to form a photosensitive layer, exposing the layer to radiation, developing the exposed resist to form the resist pattern. The resultant pattern contained contact holes.

Given that the photoresist composition is very similar to that of the Nitta et al reference and that the method of forming the resist pattern is the same as that of the Nitta et al reference, it would have been obvious to one of ordinary skill in the art to prepare the material of the Nitta et al reference, choosing to form contact holes in the resist layer which is conventional feature for a resist pattern well known in the art with reasonable expectation of achieving a resist pattern having high contrast and resolution of patterning, high photosensitivity, high film thickness retention, and excellent cross sectional image profile.

Allowable Subject Matter

9. Claims 8-19 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

With respect to the present claims 8-19, the specification presents a description of the preferred co-polymer resin B-2 beginning of page 7 of the specification and in the examples of the instant specification. Given the description beginning on page 8 of the present specification and the examples of the present specification (see examples 3 and 4), it can be determined that a resin comprising 75% p-hydroxystyrene, 7% styrene, 14% 1-ethylcyclohexyl acrylate, and 4% 2,5-dimethylhexanediol diacrylate monomeric units will meet the present claim limitations for the rate of the reduction of thickness. Furthermore, in the examples of the instant specification, applicants vary the percentages of the same 4 monomers which results in much different rates of the reduction of thickness. This co-polymer falls within the scope of the most preferred B-2 resin which is further described in the present claims 13-19, thus in order to meet the limitations of the present claims 8-12 (as well as 13-19), a co-polymer of the type described by the present claims 13-19 must be present. The examiner has performed a search of the relevant prior art and submitted the co-polymer to have a structure search performed by a PTO staff member. Both searches failed to produce any references which taught or suggested the presently claimed co-polymer. Nishimura et al (JP 2001-166478 and its partial English language translation) teach a very similar polymeric resin. Co-polymer A-5 of the reference comprises 80% 4-hydroxystyrene, 15% p-t-butoxystyrene, 5% 2-methyl-2-adamantyl acrylate, and 3% 2,5-dimethyl-2,5-hexanediol diacrylate. This polymer is quite similar to that presently claimed, however the styrene monomer has a p-t-butoxy substituent and is employed in a much larger percentage than the styrene monomer in the co-polymer of the present invention, and the acrylate monomer has 2-methyl-2-adamantyl substituent instead of the 1-ethylcyclohexyl acrylate of the presently disclosed acrylate monomer, and is used in a much smaller amount. Given that the present examples serve

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as a guide as to what polymeric compositions will meet the present claim limitations, and that the reference teaches a co-polymer that does structurally meet the broad limitations of the present claims 8-12, but does not employ the same 4 monomers or percentages of the monomeric units, thus it is the position that the disclosed co-polymer of Nishimura et al does not meet the present claim limitations. Therefore, prior art of record fails to teach or suggest to one of ordinary skill in the art to employ a co-polymeric resin comprising the four specific monomers as described by the present claims 8-19 in a method of preparing a semiconductor device.

Conclusion

10. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Breyta et al (5,492,793), Sato et al (5,800,964), Takemura et al (5,759,739), Oomori et al (6,255,041), Kawamura et al (5,731,123), Kodama (6,060,213), Padmanaban et al (5,738,972), Seki et al (6,395,446), Subramanian et al (6,274,289), Allen et al (5,962,184), and Takeda et al (5,352,564) are cited for their teachings of photosensitive polymers of the type presently claimed, but these references fail to specifically teach the preferred resins of the instant invention which meet inherently meet the rate of the reduction of the thickness limitation of the present claims.

Nitta et al (5,945,248) and Oomori et al (6,245,930) are cited as being quite similar, basically cumulative to the Nitta et al reference employed in the 102 (b) rejection above, but neither reference specifically focuses on achieving a high rate of film thickness retention which the above cited Nitta et al reference does.

Takemura et al (5,759,739) is cited for its teaching of a similar resin to those presently claimed. In column 5 of the reference, it is taught that 10-30 mol % of the hydroxyl groups of the

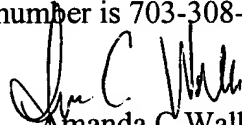
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polyhydroxystyrene monomer are substituted with t-butyl or t-butoxycarbonyl groups, however, the co-polymeric resins comprising these monomers are not all that similar to the presently claimed and disclosed co-polymers, therefore they fail to meet the present claim limitations.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Amanda C Walke whose telephone number is 703-305-0407. The examiner can normally be reached on M-R 5:30-4.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Janet Baxter can be reached on 703-308-2303. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9310 for regular communications and 703-872-9311 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0661.


Amanda C Walke
Examiner
Art Unit 1752

ACW
June 30, 2003